REMARKS

Applicants thank the Examiner for the thorough consideration given the present application. Claims 1, 2, 7-9, 15, 16, 18, 19, 21-23, 25, 34, 35 and 37-40 are currently being prosecuted. The Examiner is respectfully requested to reconsider his rejections in view of the amendments and remarks as set forth below.

Entry of Amendment

Since the present Amendment After Final Rejection is being filed with a Request for Continued Examination, entry of this Amendment is considered to be proper.

Rejection Under 35 USC 103

Claims 1, 2, 7-9, 11, 15, 16, 18, 19, and 21-25 stand rejected under 35 USC 103 as being obvious over Ngo et al. (U.S. Published Application 2002/0162736) in view of Wu et al. (U.S. Published Application 2003/0022513) and Seshan et al. (U.S. Patent 6,352,940). This rejection is respectfully traversed.

The Examiner states that Ngo teaches a method of forming a metal damascene structure including forming a cap layer on a metal layer, forming a dielectric layer on the cap layer, etching the dielectric layer and the cap layer to form a damascene opening where the etching forms impurities such as polymeric deposits and treating the exposed first metal layer using a plasma process including an NH_3 plasma and an N_2 and H_2 plasma to remove the impurities. The Examiner admits that Ngo et al. fails to teach etching using a fluorine containing plasma or a chlorine containing plasma and where the plasma further includes nitrogen and oxygen.

Applicants submit that Ngo et al. shows a method of forming low resistance vias in which the low resistance vias are formed by treating the surface of a lower metal feature with an NH_3 plasma followed by N_2 and H_2 plasmas thereby removing any oxide on the metal surface and

removing residual polymers generated during etching to form the opening. It should be noted that the plasma treatment does not use an N_2O plasma.

The Examiner relies on Wu et al. to teach etching the dielectric layer by means of reactive ion etching using a fluorine containing a plasma recipe wherein the plasma creates impurities in the dielectric layer and providing a plasma treatment with the hydrogen-containing gas, a nitrogen-containing gas and an oxygen-containing gas to remove impurities. The Examiner feels it would have been obvious to enable the etching process of the Ngo et al. according to the teachings of Wu et al.

Applicants submit that Wu et al. discloses a polymer debris pre-cleaning method, in which a gas mixture selected from the group of nitrogen and oxygen is provided after an etching process using fluorocarbon reacting gas. The gas mixture includes oxygen and nitrogen, hydrogen and argon, argon and nitrogen or oxygen and argon. The plasma generated from the gas mixture is then used to perform a pre-cleaning of the polymer debris. It should be noted that the plasma does not utilize N_2O.

The Examiner relies on Seshan et al. to teach a method of treating a substrate surface with a plasma comprising N_2O where the plasma is a well known agent to clean surfaces from contaminants such as hydrocarbons and fluorine residues from the etching process. The Examiner feels it would have been obvious to use an N_2O plasma as the cleaning agent in the process of Ngo et al. and Wu et al.

Applicants submit that the N_2O plasma treatment disclosed by Seshan et al. causes micro-roughening on the surface of the oxide layer 28. It is well known in the art that micro-roughening at the interface between two materials improves the adhesion between these materials. That is, the plasma treatment is employed to provide a layer with a rough surface, rather than to clean a surface of copper or copper alloy from contaminants. Thus, there is no reason to employ an N_2O plasma in the methods disclosed by Ngo et al. and Wu et al. The Examiner has asserted that Seshan et al. teaches treating a substrate surface with an N_2O plasma

as a well known agent to clean oxide surface from contaminants such as hydrocarbons and fluorine residues from etching processes. Applicants disagree. Seshan et al. teaches the N_2O plasma as a well known agent to clean fluorine residues from metal etch. Such metal etch does not imply copper or copper alloy etch because it is well known that a copper or copper alloy material would not be patterned or removed by etching. That is, N_2O plasma is not a well known agent to clean and treat the surface of a copper or a copper alloy layer.

Furthermore, Applicants submit that there is no motivation to combine Ngo et al. or Wu et al. with Seshan et al. because N_2O plasma is not a well known agent to clean or treat the surface of a copper or copper alloy layer. Applicants have amended claims 1 and 18 to make it clear that the metal layer is a copper or copper alloy layer, as was previously recited in claims 11 and 24. Accordingly, Applicants submit that that both claims 1 and 18 are not obvious over the combination of references.

Claims 2, 7-9, 15 and 16 depend from claim 1 and claims 19, 21-23 and 25 depend from claim 18, and as such are all considered to be allowable as well. In addition, each of these claims recite other features that make them additionally allowable.

Claims 34, 35 and 37-40 stand rejected under 35 USC 103 as being obvious over Ngo et al. in view of Wu et al., Huang (U.S. Published Application 2002/0054962) and Seshan et al. This rejection is respectfully traversed.

The Examiner relies on Huang to teach the use of organic photoresists as part of the patterning process in the formation of the interconnects. The Examiner feels that it would be obvious to combine the teachings of Ngo et al. with Wu et al. with Huang to enable patterning of the dielectric layer of Ngo et al. and Wu et al. The Examiner admits that the combination of Ngo et al. , Wu et al. and Huang fail to teach the plasma with N_2O.

Applicants submit that Huang discloses a plasma treatment to improve adhesion and oxidation resistance of carbon-containing layers, where an exposed surface of a carbon-

containing material is treated with nitrous oxide (N_2O) plasma. The plasma treatment is performed on the carbon-containing material, rather than a copper or copper alloy layer. The plasma treatment is employed to improve adhesion and oxidation resistance of carbon-containing layers, rather than to clean the surface from contaminants. Thus, there is no reason to employ N_2O plasma in the methods disclosed by Ngo et al. and Wu et al. Furthermore, Huang does not each that the plasma treatment can clean impurities on a copper or copper alloy layer.

Accordingly, Applicants submit that the combination of Ngo et al. and Wu et al. and Huang do not teach the present invention and that the present claims would not be obvious thereover. Furthermore, Applicants submit that there is no motivation to combine the references. Accordingly, Applicants submit claim 34 is likewise allowable.

Claims 35 and 37-40 depend from claim 34 and as such are also considered to be allowable. In addition, each of these claims recite other features which make them additionally allowable.

Conclusion

In view of the above remarks, it is believed that the claims clearly distinguish over the patents relied on by the Examiner, either alone or in combination. In view of this, reconsideration of the rejections and allowance of all of the claims are respectfully requested.

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Respectfully submitted,

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